FORMERLY USED DEFENSE SITE INSPECTION
OF THE
ELKTON FARM FIREHOLE
(MD-433)

November 2003

Prepared by: Maryland Department of the Environment
Waste Management Administration
1800 Washington Blvd.
Baltimore, MD 21230

Prepared for: U.S. Environmental Protection Agency
Region III
1650 Arch Street
Philadelphia, PA 19103-2029

ORIGINAL

Table of Contents

TABLES

FIGURES

APPENDIXES

1.0 INTRODUCTION

1.1 Authorization

This Site Inspection was performed by the Maryland Department of the Environment, Waste Management Administration (MDE/WAS), Environmental Restoration and Redevelopment Program (ERRP), Site Assessment/State Superfund Division under the 2001 Cooperative Agreement with the U.S. Environmental Protection Agency (EPA).

1.2 Scope of Work

The MDE/ was contracted to perform a Formerly Used Defense Site (FUDS) Inspection of the Elkton Farm Site (MD-433). The purpose of the FUDS Inspection is to assess the actual and potential release of hazardous waste from the site by way of groundwater, surface water, soil exposure and air pathways on sites that were owned and/or operated by the Federal government. The scope of the FUDS Inspection included reviewing the available file information, site reconnaissance and sampling under the U.S. EPA Contract Laboratory Program (CLP).

1.3 Executive Summary and Conclusions

The Elkton Farm Firehole site is located two miles southwest of Elkton, Maryland near the intersection of Routes 40 and 279 (Figure 1). The Firehole property occupies approximately 32 acres of the 400-acre Elkton Farm and is located just south of Zeitler Road between Little Elk Creek and Laurel Run. The most recent use of the site has been as a working farm. During the decade before and during World War II the parcel had been the site of activity related to the manufacture of fireworks and munitions.

After being identified as a potentially responsible party, the U.S. Army Corps of Engineers contracted an investigation of the site operations and ownership history of the Elkton, Maryland site of Triumph Explosives, Inc. In February 1992, the final report for this project was prepared by TechLaw, Inc. This report identified an area on the current Elkton Farm as the Firehole. This Firehole was documented as an area for the disposal of waste material from the manufacture of explosive ordnance. This waste material was reportedly collected in drums and kept wetted with alcohol or ether. The waste was then carried to a shallow pit off Zeitler Road, spread thinly and allowed to burn. Plant personnel monitored the burn until the waste explosive was ostensibly consumed. Photographs in the TEI newsletter from the period of concern show the operation of this Firehole burn pit.

The total quantity of hazardous waste disposed of in the Firehole is unknown. There is no estimate of fill thickness for the Firehole. A geophysical survey conducted by NAEVA Geophysics, Inc. (NAEVA) indicated several distinct anomalies on the portion of the property east of Laurel Run and south of Zeitler Road. Observations indicate that the Firehole is not one discrete area but rather a series of burn pits located across the property in an approximate 32-acre area.

The Firehole was reportedly the subject of a cleanup that saw the removal of tens of tons of contaminated soil. According to two separate sources, Mr. Patrick Herron and Mr. Richard Herron, soil was removed from an area where crops would not grow, and clean soil was brought in to fill the excavation. The removed soil was said to have contained scraps of brass shell casing and metallic slag.

A sampling plan to characterize the 32-acre Firehole site was prepared by MDE after site reconnaissance and a review of available historic information of the area. On October 10 and 11, 2002, as part of the FUDS inspection, MDE collected fourteen surface soil samples, ten subsurface soil samples, six surface water samples, and six sediment samples. The samples were analyzed for the presence of metals and cyanide, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides and polychlorinated biphenyls (PCBs), perchlorates and nitroaromatic compounds. On May 21, 2003, to finalize data collection for the FUDS inspection, MDE collected five groundwater samples and had them analyzed for the presence of total and dissolved metals, VOCs, SVOCs, pesticides and PCBs, nitroaromatic compounds, and perchlorates.

A toxicological evaluation was prepared for the Firehole site, assuming a residential future use scenario for the site. EPA recognizes an acceptable Hazard Index of values less than or equal to 1 (noncarcinogenic chemicals) and a lifetime cancer risk less than or equal to 10^{-6} to 10^{-4}. MDE recognizes threshold Hazard Index values equal to 1 and lifetime cancer risk threshold values less than or equal to 1×10^{-5}. Risk estimates exceeded EPA and MDE recommended levels for the child resident population for incidental ingestion of and dermal contact with surface soils, with the risk drivers of potential additive effects, chromium, and arsenic. Concentrations detected exceeded the EPA and MDE recommended levels for ingestion of and dermal contact with subsurface soil for the child resident, with the risk drivers of potential additive effects and chromium. Lead was detected in S14 at 1480 mg/kg, which may pose a threat to sensitive populations and the environment. Risk estimates for the incidental ingestion of and dermal contact with groundwater exceeded MDE and EPA recommended levels for all residential populations, with trichloroethene as the risk driver.

Samples S13 and S14 were collected in the area defined by the NAEVA geophysical survey as the most likely area of the Firehole. Sample analysis showed elevated concentrations of lead, mercury, and arsenic as well as Trichloroethene and PCBs (Aroclor 1254), and the nitroaromatic compound Trinitrotoluene (TNT) and associated daughter products. The groundwater collected from monitoring well MW2, which is hydraulically downgradient of S13 and S14, was contaminated with TCE at 160 µg/L. Subsurface soil samples from the Firehole area were not collected because of refusal at less than 18 inches. Samples S/SS6 obtained from the vicinity of the Thiokol Motor Recovery Area (TMRA) and sample S8 midway between the Firehole and TMRA also exhibited elevated levels of several explosive compounds

According to the current owners of the property, the Elkton Farm property is for sale. It is currently leased to a commercial farm for seasonal crops; however, in all likelihood, the entire 300-acre farm will be developed for residential use in the future, rather than continued use for

farming. The presence of TNT and daughter products, elevated concentrations of metals, highly volatile TCE detected in surface soils and groundwater and the presence of ordnance-related debris easily observable on the ground surface all suggest that further investigation is necessary in order to fully identify any human health risks to future residential populations.

2.0 SITE DESCRIPTION

Elkton Farm is located at 183 Zeitler Road, Elkton, Cecil County, Maryland (Figure 1). The farm itself consists of approximately 400 acres and is situated in a rural setting just north of Triumph Industrial Park. The farm is currently owned by MARVA Limited Partnership. The property has historically been a working farm. For a brief period in the mid-1940s to the early 1950s, the property was impacted by military operations. MARVA Limited Partnership leases the property to a commercial farming operation that continues to rotate several seasonal crops through the Elkton Farm's fields. There are no access limitations to this property.

As a result of the military operations in the 1940s, four areas of concern were identified:

- Unit One was addressed by a CERCLA cleanup in the early 1990s.
- Unit Two is the site of the historic "Firehole", where waste explosives were disposed through open burning.
- Unit Three is the site of a Morton Thiokol rocket test/cleaning center and has addressed by a separate investigation.
- Unit Four is a parcel of property adjacent to the G. E. Railcar property and is the potential source of a chlorinated solvent plume. This has been addressed by a separate investigation.

ORIGINAL

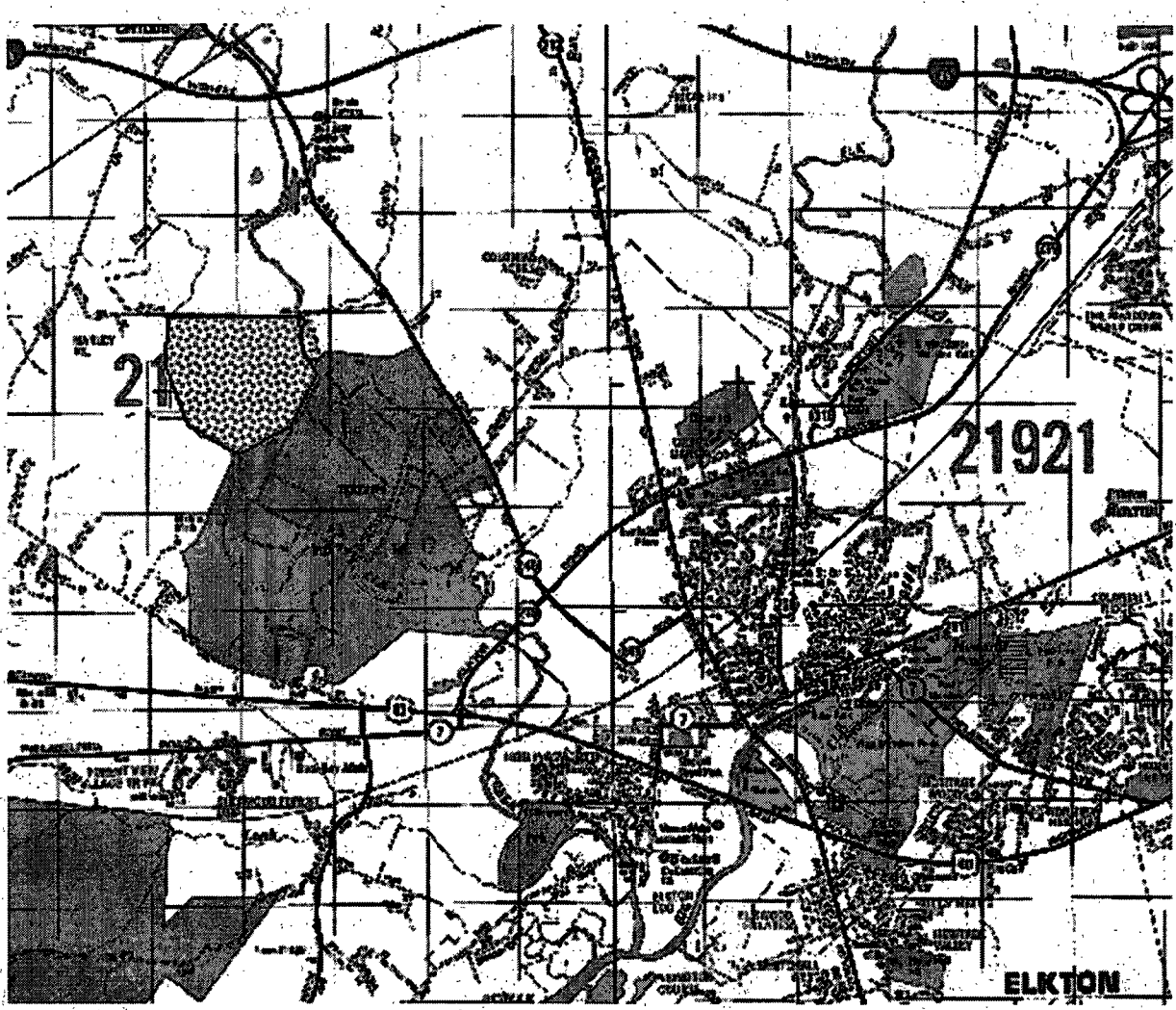
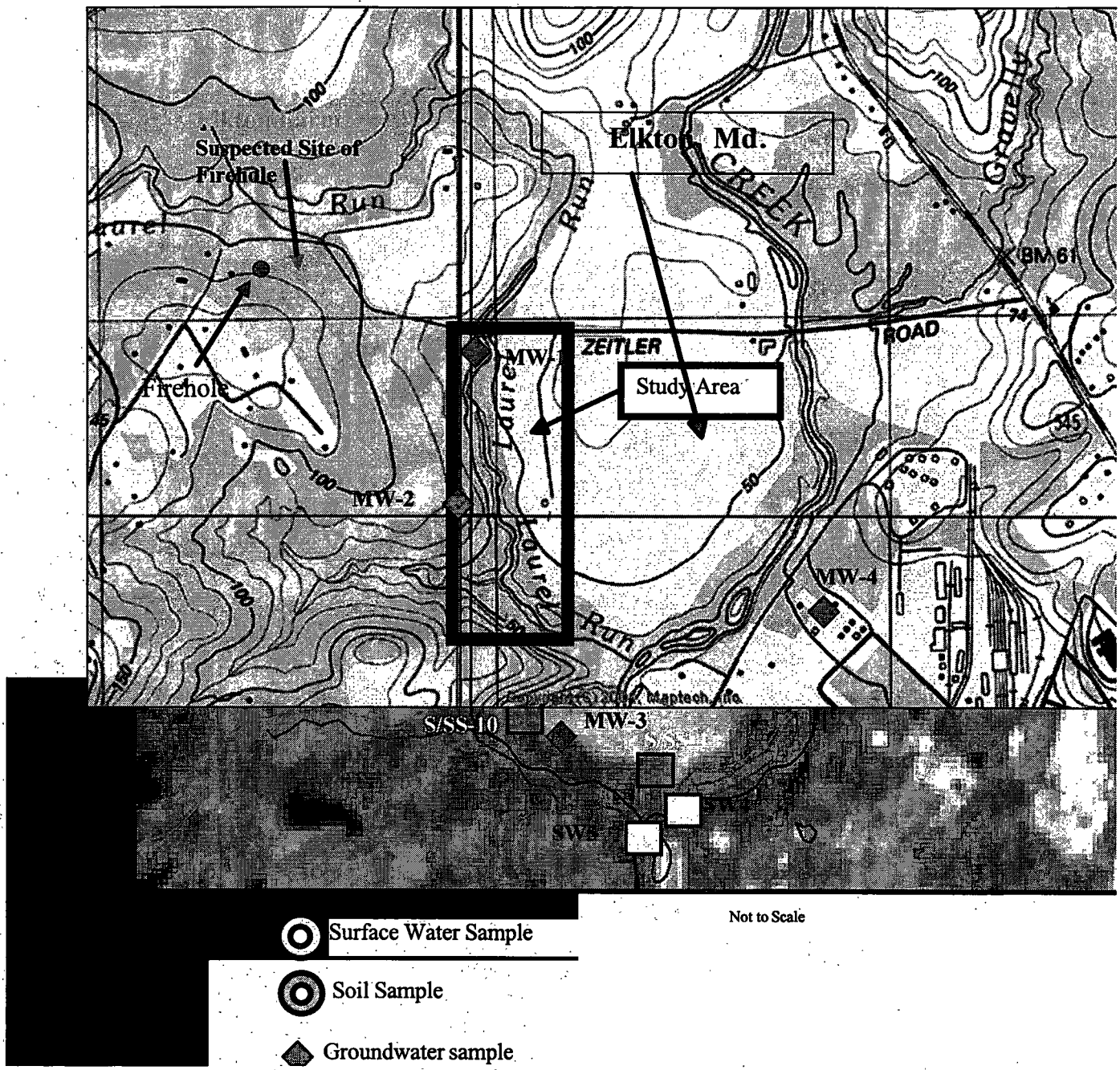


FIGURE 1 – REGIONAL AND LOCAL MAP



This report addresses Unit Two, the Firehole portion of the property. The Firehole parcel is located on the USGS Bayview/Newark West quadrangles at approximately 39°38' north latitude and 75°53' west longitude and has a Maryland grid coordinate of 655,000 N and 1,117,500 E. The roughly triangular 32-acre site is bounded on the west by Laurel Run, to the north by Zeitler Road, and to the East by Little Elk Creek (Figure 3). A gravel access road bisects the western quadrant of the site. The Firehole is in this western quadrant west of the gravel road. Land use surrounding the site is primarily agricultural/residential, with an area of medium to heavy

industry property to the southeast across Little Elk Creek.

2.1 Site Ownership and Use

Throughout most of its history, Elkton Farm has been used as a livestock farm with much of the surrounding fields under cultivation. During the early 1940s, Triumph Explosives, Inc. acquired ownership of the Elkton Farm. During the period between the end of World War II and the 1970s, hazardous material was stored and/or disposed of on the farm. Four hazardous waste disposal areas have been identified:

Unit One

- Unit One is an area of the farm that was used by a property owner for the storage of hazardous waste, including drums of ash produced from the Thiokol area (Unit 3), ordnance from the Triumph Explosives Inc. (TEI) operation and drums of waste from Galaxy Chemical. In the early 1980s, the owner of the farm attempted to dispose of 53 drums of hazardous waste from Galaxy Chemical at Norris Farm Landfill in Baltimore County, Maryland. Norris Farm Landfill refused to accept the waste for disposal and Galaxy refused to take the waste back. Consequently, the owner of Elkton Farm stored the drums in the two farm buildings until he reported them to MDE almost ten years later. A Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) removal action was completed at Unit One in 1992, which resulted in the removal of drums containing flammable organic compounds, base neutral compounds, halogenated organic compounds, drums of solids, and 10 tons of contaminated soil.

Unit Two

- Unit Two, the subject of this report, is a World War II-era waste ordnance combustion pit know as the "Firehole," which was used by TEI during the 1940s. The Firehole was defined as the area for the disposal of waste explosives materials generated by the operations at TEI. TEI reportedly collected waste material from the manufacture of explosive ordnance and placed it in drums. This accumulated waste was kept wetted with alcohol or ether to prevent spontaneous combustion, and then carried to a shallow pit off Zeitler Road, spread thinly, and allowed to burn. Plant personnel monitored the burn until the waste explosive was consumed. Photographs in the TEI newsletter from the late 1940s show the operation of the Firehole burn pit. Ordnance-related debris was observable on the ground surface during the sampling event (see Photographs P-1).

Unit Three

- Unit Three is a 1-acre plot of land leased by the Thiokol Corporation for the operation of a rocket motor cleaning and recovery area in the late 1950s and early 1960 (Unit Three overlays a component of Unit Two). The abandoned structures for this test area are located on the west side of the property. MDE currently has little

information regarding the operation of this "rocket test area."

Unit Four

- Unit Four is an area on the farm reportedly used during this same era to dispose of waste organic solvents.

TEI purchased the Elkton Farm property in the early 1940s. The current owners, the Herron family, acquired the property in 1948. In the late 1950s and early 1960s, the Thiokol Corporation leased a one-acre plot of the property. The farm property is currently leased to a commercial farming operation that rotates several seasonal crops through the fields.

2.2 Permitting and Regulatory Actions

There are no permits on file with MDE for the disposal of waste material at the Firehole on the Elkton Farm property.

2.3 Remedial Actions

There have been no remedial actions conducted in the area of the Firehole.

3.0 ENVIRONMENTAL SETTING

3.1 Water Supply

Drinking water for the Elkton area is obtained from an intake on Big Elk Creek and two municipal production wells. The total amount of municipal water withdrawn from these three sources is estimated to be 1.7 million gallons per day. The estimated number of domestic wells and non-transient non-community wells and populations they serve is represented in Table 1.

Table 1 – Domestic Water Sources within a Four-Mile Radius of Site

RING DISTANCE FROM THE SITE	ESTIMATE NUMBER OF DOMESTIC WELLS	ESTIMATED POPULATION SERVED*	COMMUNITY AND NONTRANSIENT NONCOUMMUNITY SYSTEMS	ESTIMATED POPULATION SERVED
0 – 1/2 mile	30	80	1	300
½ - 1 mile	70	183	0	500
1 – 2 miles	237	621	1	4300
2 – 3 miles	176	461	0	9100
3 – 4 miles	287	752	0	9300
Total	**800**	**2096**	**2**	**23500**

*According to 1998 U.S. Census data, the average population per household is 2.62.

3.2 Surface Waters

The Elkton Farm property lays at the confluence of Little Elk Creek with Laurel Run. Natural drainage on the site is in a generalized north to south direction. There is a slight drainage divide on the property which directs surface runoff to either Laurel Run or Little Elk Creek. Surface water infiltrates the soil to groundwater, or is discharged via overland flow to Laurel Run or Little Elk Creek. Laurel Run discharges into Little Elk Creek which flows southward into Big Elk Creek and eventually to the Chesapeake Bay.

The farthest upstream probable point of entry for the surface water route originates at the on-site drainage ditch on the Zeitler Road border of the site. The drainage ditch travels west for approximately 500 feet before emptying into Laurel Run. Laurel Run flows 0.625 miles to its confluence with Little Elk Creek. The area of the confluence of Laurel Run and Little Elk Creek is classified as Palustrine Aquatic Bed wetlands. Little Elk Creek flows south southeast for approximately 4.0 miles before emptying into the Big Elk Creek. Big Elk Creek flows approximately 2.25 miles to the point where it empties into Elk River. Elk River flows approximately 12.0 miles to its confluence with the Chesapeake Bay. The 15-mile surface migration pathway ends in the Chesapeake Bay three miles from the confluence of Elk River with the Bay. The Chesapeake Bay is classified as Estuarine intertidal wetlands and is a fishery.

3.3 Soils

Elkton Farm's soils are characterized as having been formed in the soft, unconsolidated, water-lain Cretaceous and Pleistocene sediment of the Atlantic Coastal Plain. The soil series found on the Elkton Farm are a combination of Elsinboro, Mattapex, and Othello silt loams all having slopes of less than 5 percent. Elsinboro series soils are deep, well drained soils found on terraces above the flood plains of major streams. Elsinboro soils are formed in old, micaceous alluvium. Mattapex soils consist of deep moderately well drained loamy soils that formed in silty material laid down on older, coarser sediment. Othello series soils are poorly drained loamy soils on upland flats. These soils were formed in silty material underlain by coarser sediment.

Most of the hardwood vegetation native to these three soil series are noted to have been cleared for use as cropland.

3.4 Geology and Groundwater

Elkton Farm lies in the erosional remnants of the Coastal Plain physiographic province, near the Fall Line. The unconsolidated sediments of the Coastal Plain extend eastward from the Fall Line, dipping eastward and becoming progressively thicker with distance, eventually reaching over 8,000 feet in thickness at Ocean City.

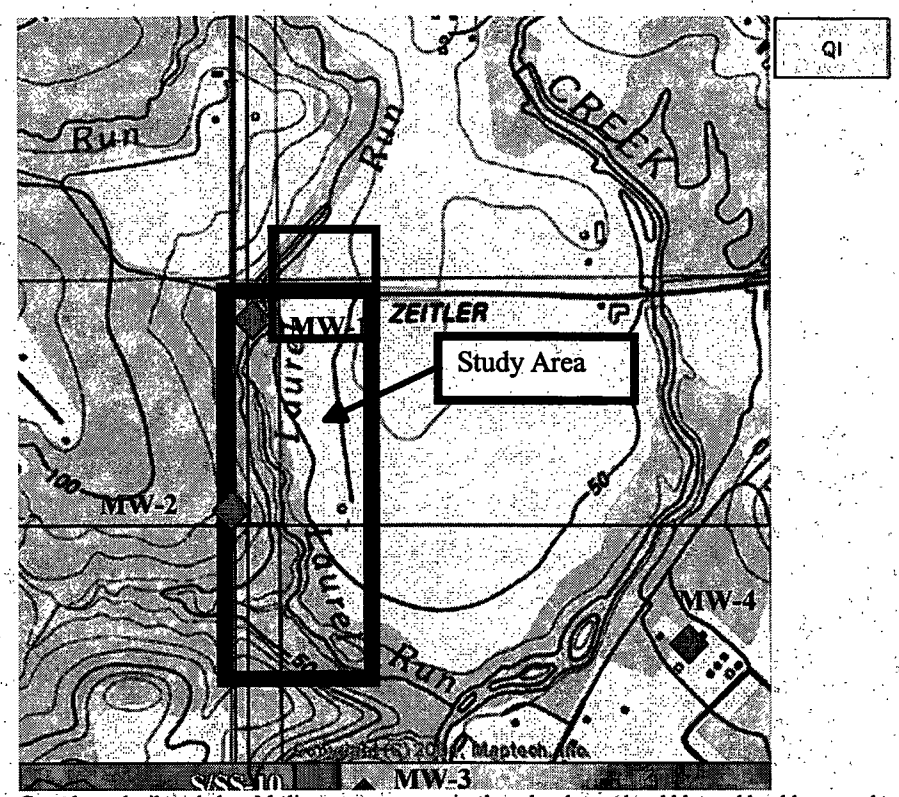
The quaternary strata at the Elkton Farm Firehole site (Figure 2) is classified as Uplands Deposits, which includes the Pamlico, Talbot, Wicomico and Sunderland Formations of earlier reports. The Uplands Deposits consists a floodplain-deposited formation comprising lenses of micaceous sand and gravel interbedded with thin layers of silt and fine sand. The coarse-grained sands and gravels at the base of the formation can range in size to boulders 8 foot in diameter.

Shallow groundwater was not encountered in any Elkton Farm Geoprobe borings during the October 2002 sampling event. This fact was due primarily to the severe drought in the years prior to the sampling. A review of well logs for several test wells within 0.5 mile of the site indicates that shallow groundwater is anticipated at depths of 20 feet or less.

In order to define the groundwater component at the Firehole, MDE contracted Earth Matters, Inc., to drill several monitoring wells. Four 2-inch monitoring wells were installed in March 2003 to monitor groundwater at the site. Wells were set at between 20 to 30 feet below ground surface, with 15 feet of threaded PVC screen, a gravel-pack to one foot over the screened interval and a clay grout above the gravel-pack to less than one foot below ground surface.

The well located at the Herron Farm farmhouse was used as a domestic groundwater sample for this investigation. The depth and casing levels for the well located at the farmhouse is not recorded. The farmhouse well is estimated to approximate the lower range of the 99-foot average depth of the top of screen for domestic production wells in the Elkton area.

FIGURE 2 – Generalized Geological Map of the Elkton Area



Ql

Lowland Deposits

Gravel, sand, silt and clay. Medium- to coarse-grained sand and gravel; cobbles and boulders near base; commonly contains reworked Eocene glauconite; varicolored silts and clays; brown to dark gray lignitic silty clay; contains estuarine to marine fauna in some areas (includes in part Pamlico, Talbot, Wicomico and Sunderland Formations of earlier reports); thickness 0 to 150 feet

Qu **Upland Deposits (Eastern Shore)**

Gravel, sand, silt, and clay. Mostly cross-bedded, poorly sorted, medium- to coarse-grained white to red sand and gravel, boulders near base; minor pink and yellow silts and clays; (Wicomico Formation of earlier reports); thickness 0 to90 feet, locally thicker in paleochannels.

QTu **Upland Deposits (Western Shore)**

Gravel and sand, commonly orange-brown, locally limonite-cemented; minor silt and red, white, or gray clay; (includes Brandywine, Bryn Mawr, and Sunderland Formations of earlier reports); lower gravel member and upper loam member in Southern Maryland; thickness 0 to 50 feet

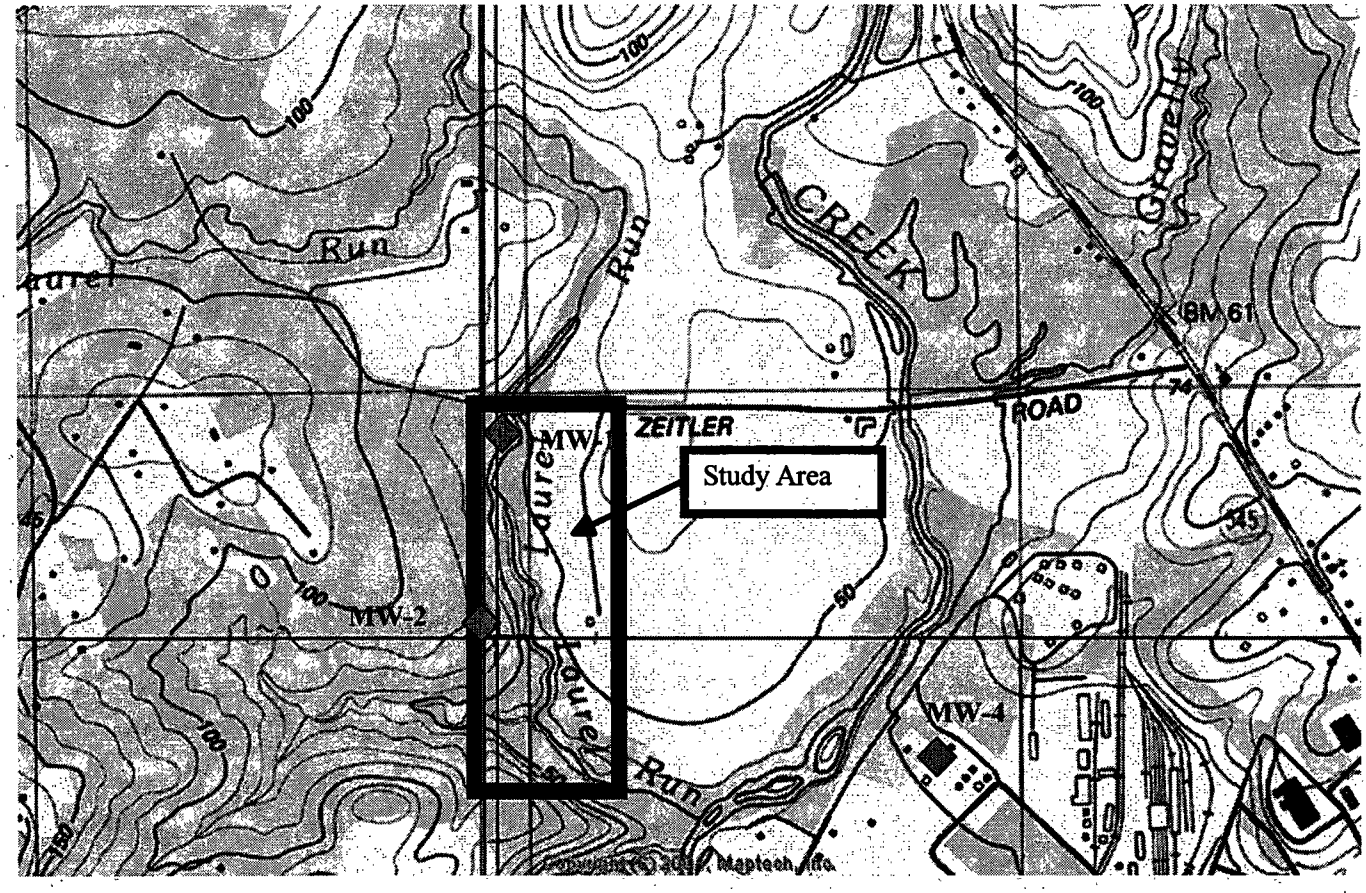
Kp **Potomac Group**

Interbedded quartzose gravels; protoquartzitic to orthoquartzitic argillaceous sands; and white, dark gray and multicolored silts and clays; thickness 0 to 800 feet.

Pzpd **Port Deposit Gneiss**

Moderately to strongly deformed intrusive complex composed of gneissic biotite quartz diorite, hornblende-biotite quartz diorite, and biotite granodiorite; all rocks foliated and some strongly sheared; age 550 +/- 50 m.y.* by radiogenic dating.

Figure 3 – Topographic Map



3.5 Meteorology

The climate is temperate and humid with an average of 180 freeze free days. The average temperatures range from 74.1 degrees Fahrenheit in the summer to 34.0 degrees Fahrenheit in the wintertime. The mean annual precipitation is about 45.3 inches with an average snowfall on the order of 18 inches per year.

3.6 Nearby Land Use and Population Distribution

Land use surrounding the site is primarily agricultural/residential, with an area of medium to light industry situated to the south across Little Elk Creek. There are four residences located along Zeitler road. The two closest to the study area, which were directly associated with the historic farming operation, are currently occupied. The Triumph Industrial Park is located a short distance south of the intersection of Zeitler Road and Blue Ball Road (MD-545). Triumph Industrial Park is located on the site of but is unrelated to former TEI operations. Several industrial and chemical operations, including GE Railcar, and Thiokol Corporation, now occupy space in the industrial park.

Table 2 – Population Distribution

Radius (miles)	Population
0 – 0.25	134
0.25 – 0.5	217
0.5 – 1.0	672
1.0-2.0	5001
2.0 – 3.0	9581
3.0 – 4.0	11,451
Total	**27,056**

The resident population distribution around the site was determined using Maryland census figures for the year 2000.

4.0 WASTE DESCRIPTION

After being identified as a potentially responsible party, the U.S. Army Corps of Engineers contracted an investigation of the site operations and ownership history of the Elkton, Maryland site of Triumph Explosives, Inc. In February 1992, the final report for this project was prepared by TechLaw, Inc. This report identified an area on the current Elkton Farm as the Firehole. This Firehole was documented as an area for the disposal of waste material from the manufacture of explosive ordnance. This waste material was reportedly collected in drums and kept wetted with alcohol or ether. The waste was then carried to a shallow pit off Zeitler Road, spread thinly and allowed to burn. Plant personnel monitored the burn until the waste explosive was ostensibly consumed. Photographs in the TEI newsletter from the period of concern show the operation of this Firehole burn pit.

The total quantity of hazardous waste disposed of in the Firehole is unknown. There is no estimate of fill thickness for the Firehole. A geotechnical survey conducted by NAEVA indicated several distinct anomalies on the portion of the property east of Laurel Run and south of Zeitler Road. Observations indicate that the Firehole is not one discrete area but rather a series of burn pits located across the property in an approximate 32-acre area.

The Firehole was reportedly the subject of a cleanup that saw the removal of tens of tons of contaminated soil. According to two separate sources, Mr. Patrick Herron and Mr. Richard Herron, soil was removed from an area where crops would not grow, and clean soil was brought in to fill the excavation. The removed soil was said to have contained scraps of brass shell casing and metallic slag.

5.0 PREVIOUS STUDIES

In April 2001, MDE performed a Site Survey of the Elkton Farm site to determine

whether further action was necessary. The finding of this survey was that further action was required in order to document potential hazards associated with a release of site contaminants to the groundwater and surface waters of the State of Maryland.

In July 2002, MDE contracted ENSAT to conduct a geophysical assessment of an area of the Elkton Farm to identify the possible location of the Firehole. NAEVA was contracted to perform the analysis. ENSAT transmitted the NAEVA final report (Appendix C) to MDE on September 3, 2002. This report identified an area that is likely to be the location of the Firehole. All anomalies were delineated and tied to a GPS grid.

6.0 MDE Contract Laboratory Program (CLP) Sampling

MDE proposed an investigation of the Elkton Farm Firehole site in its Cooperative Agreement with EPA in Fiscal Year 2001. Accordingly, a sampling plan proposal was submitted to the EPA Region III office in May 2002 for the proposed collection of groundwater, surface water, sediment and soil at the site. The purpose of the sampling was to evaluate areas within and adjacent to the Firehole area for any potential contamination. EPA approved the sampling proposal in a letter dated June 21, 2002.

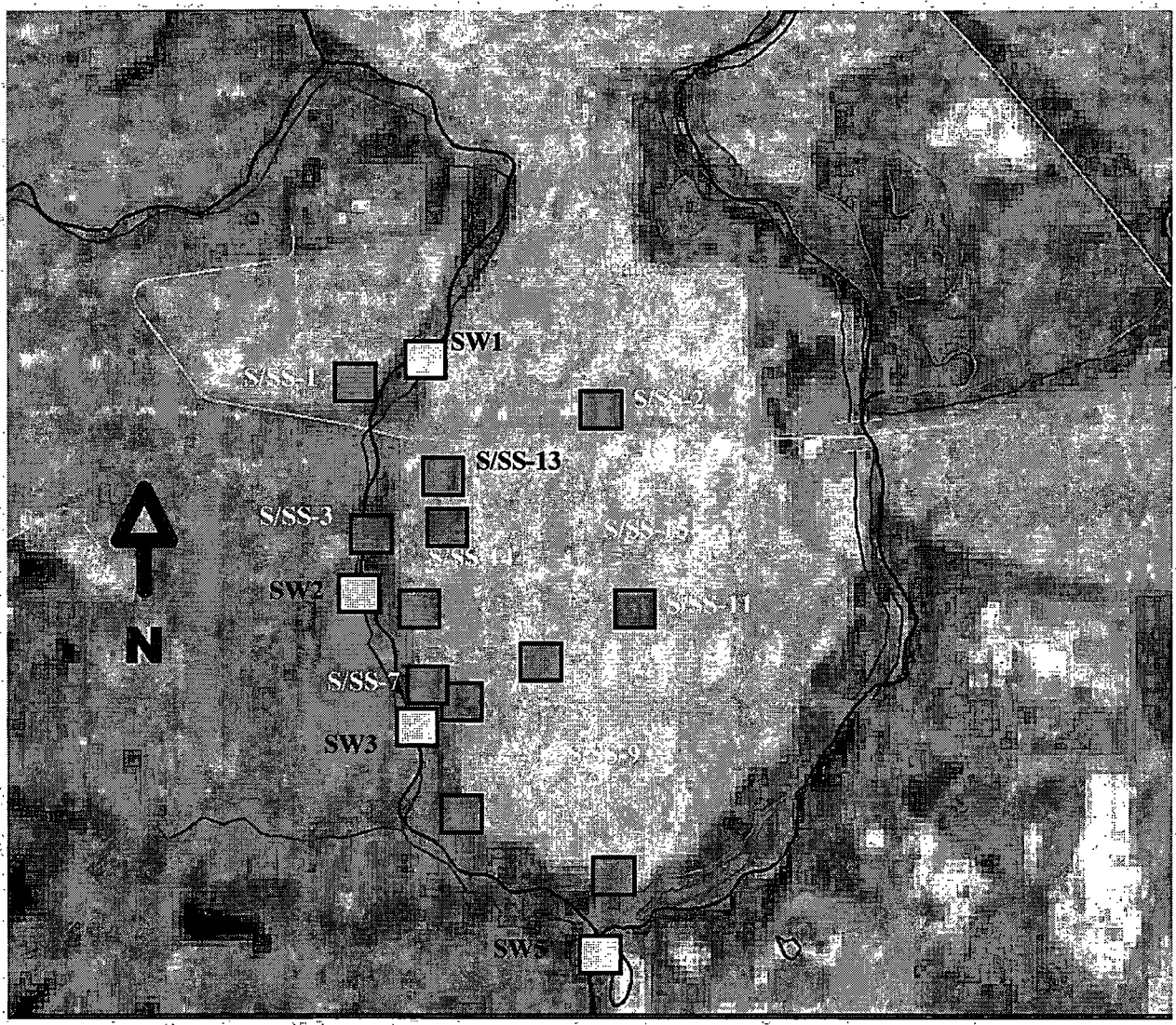
MDE personnel conducted the sampling according to procedures outlined in EPA's CLP Routine Analytic Services as Case Number R31295. Sampling began on October 8, 2002 with the collection of soil, sediment and surface water and concluded on May 21, 2003 with the collection of groundwater. All samples were analyzed for Target Analyte List inorganics, Target Compound List organics, nitroaromatic compounds and perchlorates (Appendix D). MDE collected the samples in five matrices: one organic aqueous, one organic solid, one inorganic aqueous, one dissolved inorganic aqueous and one inorganic solid. Sampling procedures for groundwater, surface water, sediment and soil are fully outlined in MDE's Standard Operating Procedures. Each matrix included the collection of a field duplicate sample and a matrix spike sample. A field blank consisting of deionized water prepared by MDE was provided for each aqueous matrix. MDE prepared trip blanks consisting of deionized water in 40 ml vials preserved with hydrochloric acid. These trip blanks were shipped and analyzed along with aqueous samples for volatile organic compounds. The sampling locations are shown on Figure 4 and the sample summary table is shown in Table 3.

Table 3 - Sample Summary Table

Sample Identification	Sample Type	Sample Location	Rationale
MW-1	Aqueous	Zeitler Rd. west of gravel road.	Up gradient/Background.
MW-2	Aqueous	Western edge of property at tree line.	Characterize site groundwater.
MW-3	Aqueous	Southern edge of property at tree line	Characterize site groundwater.
MW-4	Aqueous	Eastern edge of property at tree line	Characterize side-gradient groundwater.
GW-5	Aqueous	Duplicate of MW-2	Duplicate of MW-2
SW-1	Aqueous	Laurel Run upstream of Zeitler Road	Background.
SW-2	Aqueous	Laurel Run adjacent	Determine if waste source has traveled off site.
SW-3	Aqueous	Laurel Run midway	Determine if waste source has traveled off site.
SW-4	Aqueous	Little Elk Creek upstream	Determine if waste source has migrated to tributary.
SW-5	Aqueous	Laurel Run confluence	Determine if waste source has traveled off site.
SW-6	Aqueous	Laurel Run SW-2	Duplicate Sample of SW-2.
SED-1	Sediment	Laurel Run upstream of Zeitler Road	Background.
SED-2	Sediment	Laurel Run adjacent	Determine if waste source has traveled off site.
SED-3	Sediment	Laurel Run midway	Determine if waste source has traveled off site.
SED-4	Sediment	Little Elk Creek upstream	Determine if waste source has migrated to tributary.
SED-5	Sediment	Laurel Run confluence	Determine if waste source has traveled off site.
SED-6	Sediment	Laurel Run SED-2	Duplicate sample of SED-2.

Sample Identification	Sample Type	Sample Location	Rationale
S/SS-1	Soil	Woods NW of site across Laurel Run	Area background.
S/SS-2	Soil	Along Zeitler Road east of Firehole	Characterize waste source.
S/SS-3	Soil	Along the wood line west of Firehole	Characterize waste source.
S/SS-4	Soil	Southernmost end of the field	Characterize waste source.
S/SS-5	Soil	S of Firehole Area	Characterize waste source.
S/SS-6	Soil	Motor Recovery Area structure	Characterize waste source.
S/SS-7	Soil	West of Motor Recovery Area structure	Characterize Waste Source (SS-7 not collected due to refusal at less than 18 in.)
S/SS-8	Soil	NNE of Motor Recovery Area	Characterize waste source.
S/SS-9	Soil	SE of Motor Recovery Area	Characterize waste source.
S/SS-10	Soil	South of Motor Recovery Area	Characterize waste source (SS-10 not collected due to refusal at less than 18 in)
S/SS-11	Soil	Center of Elkton Farm field	Site Background
S/SS-12	Soil	N of Motor Recovery Area	Duplicate sample of S/SS-5
S/SS-13	Soil	N Center Firehole area	Characterize waste source (SS-13 not collected due to refusal at less than 18 in)
S/SS-14	Soil	S Center Firehole Area	Characterize waste source (SS-14 not collected due to refusal at less than 18 in)

FIGURE 4 – SAMPLE LOCATION MAP
ELKTON FARM FIREHOLE



Not to Scale

Surface Water Sample

6.1 Groundwater Sampling Results

MDE collected a total of five groundwater grab samples from monitoring wells located across the site. Groundwater samples were collected in borings sequentially labeled MW-1 through MW-4. The sample designated MW-1 was collected as the site upgradient background sample. Sample GW-5 was collected as the duplicate of sample MW-2. In addition to the standard field parameters collected for this assessment, samples were submitted to EPA for nitroaromatic compounds and perchlorate analyses. A filtered grab sample was also collected from each groundwater location for dissolved metals analysis.

The laboratory data were screened against: 1) EPA Region III Risk Based Concentrations for Tap Water, and 2) MDE Cleanup Standards for Type I and II Aquifers.

No analyses exceeded 3X background for either total or dissolved metals. Iron concentrations exceeded MDE Cleanup Standards in all total metals analyses, and also exceeded EPA RBCs in MW-1, MW-4 and GW-5. Manganese exceeded MDE Cleanup Standards in all total metals analyses, and exceeded the EPA RBC in only the background sample (MW-1). Vanadium also exceeded MDE Cleanup Standards in MW-1. However, for dissolved metals analyses, only manganese exceeded MDE Cleanup Standards, and none exceeded EPA RBCs.

In MW-2 and GW-5, TCE was present at levels exceeding 3X background, MDE Cleanup Standards and EPA RBCs. 1,1,2-Trichloroethane was also present at levels exceeding EPA RBCs. Trace levels of cis-1,2-Dichloroethene was also present in MW-2 and GW-5. Trace levels of Bis(2-ethylhexyl)phthalate were detected in MW-1 and MW-2. No pesticides or PCBs detected in groundwater samples.

No perchlorates were detected in any of the groundwater samples. Trace levels of 4-amino-2,6-dinitrotoluene was detected in GW-5, but not in MW-2. No nitroaromatics were detected in any of the other groundwater samples.

Table 4 –Total Metals Data for Groundwater Samples

Total Metals
µg/l MW1
Background MW2
Dup GW5 MW3
MW4 GW5
Dup MW2 RBC1 MDE3

Cleanup Std. ALUMINUM 31,500 K 3,920 2,440 K 5,040 K 4,870 K 37,000 50 ARSENIC 8.6 B <15 6.0 J <15 <15 .045 50 BARIUM 609 188 J 120 J 122 J 205 2,600 2,000 BERYLLIUM 14.3 0.73 B 1.7 J 1.7 B 0.82 B 73 4 CALCIUM 41,600 31,800 15,800 16,600 32,700 -- -- CHROMIUM (total) 104 10.6 7.2 J 18.6 12.8 110 (Cr+6) 100 (Cr+6) COBALT 54.9 6.5 J 14.9 J 20.1 J 7.7 J 730 73 COPPER 27.3 26.3 20.9 J 36.9 29.5 1,500 1,300 IRON 73,200 10,000 7,030 21,000 12,200 11,000 300 LEAD 28.5 11.7 4.9 B <10 11.0 – 15 MAGNESIUM 28,600 19,800 8,480 12,500 20,500 -- -- MANGANESE 1,250 349 343 487 406 730 50 MERCURY 0.13 B 0.11 B <0.2 <0.2 <0.2 – 2 NICKEL 57 7.9 J 25.5 J 60.9 9.0 J 730 73 POTASSIUM 7,630J 4,590 J 1,540 J 641 J 5,090 J -- -- SODIUM 29,100 5,210 7,340 10,100 5,390 -- -- VANADIUM 113 8.9 J 11.8 J 27.5 J 11.2 J 260 50 ZINC 386 B 104 B 61.5 B 99.6 B 142 B 11,000 1,100 Qualifiers: J = analyte present, reported value may not be accurate or precise; B = not detected substantially above the level reported in laboratory or field blanks; L=Analyte present, actual value is expected to be higher; [ ] = analyte present, as values approach the instrument detection limit the quantitation may not be accurate; K = analyte present, reported value may be biased high., actual value is expected to be lower; Yellow highlight indicates that levels exceeded MDE cleanup standard; Red highlight indicates that levels exceeded both MDE cleanup standard and EPA RBC

1 – EPA Region III Risk Based Concentration for Tap Water
2 – MDE Cleanup Standards for Type I and II Aquifers

Table 5 –Dissolved Metals Data for Groundwater Samples
Total Metals
(g/l MW1
Background MW2
Dup GW5 MW3
MW4 GW5
Dup MW2 RBC1 MDE2

Cleanup Std. ALUMINUM 356 B 27.1 B 61.7 B 45.4 B 32.2 B 37,000 50 BARIUM 68.0 J 93.3 J 46.3 J 40.3 J 97.5 J 2,600 2,000 BERYLLIUM 0.72 J <5 0.2 B 0.25 B <5 73 4 CALCIUM 11,600 25,100 9,730 8,490 26,500 -- -- CHROMIUM 1.7 B <10 0.90 J <10 <10 110 100 COBALT 8.5 J 2.3 J 6.5 J 4.8 J 3.1 J 730 73 COPPER 9.5 J <25 <25 <25 1.7 J 1,500 1,300 IRON 1220 765 1240 1580 890 11,000 300 LEAD 3.4 B <10 <10 <10 <10 – 15 MAGNESIUM 6,000 15,000 5,930 7,080 15,700 -- -- MANGANESE 221 194 240 234 212 730 50 NICKEL 10.4 B 4.1 B 9.7 B 11.5 B 5.0 B 730 73 POTASSIUM 1,020 J 2,790 J 1,160 J 368 J 2,830 J -- -- SODIUM 26,800 4,790 J 6,450 9,550 5,050 -- -- VANADIUM 1.5 J <50 <50 <50 <50 260 50 ZINC 81.6 B 75.1 B 86.6 B 90.1 B 80.3 B 1,000 1,100 Qualifiers: J = analyte present, reported value may not be accurate or precise; B = not detected substantially above the level reported in laboratory or field blanks; Yellow highlight indicates levels that exceed MDE cleanup standard

1 – EPA Region III Risk Based Concentration for Tap Water
2 – MDE Cleanup Standards for Type I and II Aquifers

Table 6 – VOC Data for Groundwater Samples
Analyte
µg/l MW1
Background MW2
Dup of GW5 MW3
MW4 GW5
Dup of MW2 RBC1 MDE2

Cleanup Std. TRICHLOROETHENE <10 190 <10 <10 170 .026 5 CIS-1,2-DICHLOROETHENE <10 5 J <10 <10 5 J 61 70 1,1,2-TRICHLOROETHANE <10 2 J <10 <10 1 J .19 5 Qualifiers: J = analyte present, reported value may not be accurate or precise; Green box indicates levels that exceed 3X background; Blue highlight indicates levels exceed RBC; Red higlight indicates levels that exceed both RBC and cleanup standard

1 – EPA Region III Risk Based Concentration for Tap Water
2 – MDE Cleanup Standards for Type I and II Aquifers.

Table 7 - SVOC Data for Groundwater Samples

Analyte (g/l	MW1 Bkgrnd	MW2 DupGW5	MW3	MW4	GW5 Dup MW2	RBC1	MDE2 Cleanup Std.
BIS(2-ETHYLHEXYL)PHTHALATE	1J	2J	<10	<10	<10	4.8	200

Qualifiers: J = analyte present, reported value may not be accurate or precise.

1 – EPA Region III Risk Based Concentration for Tap Water
2 – MDE Cleanup Standards for Type I and II Aquifers.

Table 8 – Nitroaromatic Data for Groundwater Samples

Analyte µg/l	MW1 bckgnd	MW2	MW3	MW4	GW5	RBC1	MDE Cleanup Stnd2
4-AMINO-2,6-DINITROTOLUENE	–	–	–	–	0.15	37	–

1 – EPA Region III Risk Based Concentration for Tap Water
2 – MDE Cleanup Standards for Type I and II Aquifers.

6.2 Surface Water Sampling Results

MDE collected three surface water grab samples from Laurel Run and two surface water grab samples from the Little Elk Creek. SW6 was a duplicate sample of SW2. The chemicals detected in the surface water samples were screened against Toxic Substance Criteria for Ambient Surface Water (Freshwater chronic) in the Code of Maryland Regulations, Subtitle 26.08.02.03-2 and National Ocean and Atmospheric Administration (NOAA) Screening Quick Reference Table for Inorganics in Water (Surface water freshwater CCC). In addition to the TAL and TCL, surface water samples were analyzed for perchlorates.

No analyses exceeded 3X background for any of the surface water samples. Aluminum exceeded the NOAA screening levels in all surface water samples. Iron exceeded the NOAA screening level in SW1, which was the background sample. A trace level of acetone was detected in SW2. Trace levels of Bis(2-ethylhexyl)phthalate were detected in SW2 and SW4. No pesticides or PCBs were detected in any surface water samples. No perchlorates were detected in any surface water samples.

Table 9 –Total Metals Data For Surface Water Samples
Total Metals
(g/l SW1
Background SW2
Dup SW6 SW3 SW4 SW5 SW6
Dup SW2 NOAA

SQRT1 COMAR2 ALUMINUM 289 269L 324 380 407 261 L 87 -- BARIUM [65.9] [49.5]L [74.1] [38.9] [35] [50.3] L -- -- BERYLLIUM <5 <5 <5 [0.25] <5 <5 5.3 -- CALCIUM 10,100 9,160 L 9,550 5,300 13,800 8,710 L -- -- COBALT [3.4] <50 [3.4] [4.2] <50 <50 -- -- COPPER [1.3] [1.3]L [1.9] [1.3] [1.8] [1.8] L 9 9 IRON 1,960 941 L 2,510 3,570 365 936 L 1000 -- MAGNESIUM [4,870] [4,270] L [4,800] [2,800] 8,800 [4140] L -- -- MANGANESE 481 161 L 749 384 43.1 184 L -- -- NICKEL [2.5] <40 [3.3] [3.6] [1.9] [2.6] L 52 52 POTASSIUM [3,390] J [3,760] J [3,550] J [1,940] J 5,020 J [3,810] J -- -- SODIUM 27000 20,300 L 19,800 6,670 16,700 20,200 L -- -- ZINC [6.3] [2.9] L [4.7] [2.8] <20 [2.7] L 110 120 Qualifiers: J = analyte present, reported value may not be accurate or precise; [ ] = analyte present, as values approach the instrument detection limit the quantitation may not be accurate; L = analyte present, reported value may be biased low; actual value is expected to be higher; Blue highlight indicates levels that exceed NOAA SQRT.

1-National Oceanic and Atmospheric Administration Screening Quick Reference Tables for Inorganics in Water (Surface Water Freshwater CCC)

2-Code of Maryland Regulations, Sec. 26.08-Water Pollution, Table 1-Toxic Substances Criteria for Ambient Surface Waters (freshwater chronic)

Table 10 – VOC data for Surface Water Samples
Analyte
(g/l SW1
Bkgrnd SW2
Dup of SW6 SW3 SW4 SW5 SW6
Dup of SW2 NOAA

SQRT1 COMAR2 ACETONE <10 <10 <10 2 J <10 <10 -- -- Qualifiers: J = analyte present, reported value may not be accurate or precise.

1-National Oceanic and Atmospheric Administration Screening Quick Reference Table for Organics (Ambient Water Quality Criteria, Freshwater CCC)

2-Code of Maryland Regulations, Sec. 26.08-Water Pollution, Table 2-Toxic Substances Criteria for Ambient Surface Waters (freshwater chronic)

Table 11 – SVOC data for Surface Water Samples
Analyte
(g/l SW1
Background SW2
Dup SW6 SW3 SW4 SW5 SW6
Dup SW2 NOAA

SQRT1 COMAR2 BIS(2-ETHYLHEXYL)PHTHALATE <10 3 J <10 1 J <10 <10 360 -- Qualifiers: J = analyte present, reported value may not be accurate or precise.

1-National Oceanic and Atmospheric Administration Screening Quick Reference Table for Organics (Ambient Water Quality Criteria, Freshwater CCC)

2-Code of Maryland Regulations, Sec. 26.08-Water Pollution, Table 3-Toxic Substances Criteria for Ambient Surface Waters (freshwater chronic)

6.3 Sediment Sampling Results

MDE collected five sediment samples (SED1– SED5) plus one duplicate sample (SED6), coincident with the surface water sample locations. SED6 was a duplicate sample of SED2. The contaminants detected in the sediment samples were screened against the National Ocean and Atmospheric Administration (NOAA) Screening Quick Reference Table for Inorganics in Solids (Marine sediments, Threshold Effects Levels (TEL) and Effects Range Median (ERM)). In addition to the TAL and TCL, sediment samples were analyzed for perchlorates.

Sample SED5 exceeded 3X background for all inorganics, which indicates that this area of the stream has been impacted by former operations on Elkton Farm. However, only cadmium, copper, mercury and nickel concentrations exceeded the NOAA SQRT TEL. Trace levels of Caprolactam, Bis(2-ethylhexyl)phthalate, Acetone, Methylene chloride and alpha-BHC were also detected in various samples, but did not exceed the NOAA screening levels. No PCBs were detected in any sediment samples. No perchlorates were detected in any sediment samples.

Table 12 – Total Metals Data For Sediment Samples
Analyte
mg/kg SED1
Bkgrnd SED2
(Dup SED6) SED3 SED4 SED5 SED6
(Dup SED2) NOAA1
SQRT
(TEL) NOAA1 SQRT

(ERM) ALUMINUM 1,760 373 2,050 1470 11,600 461 -- -- ARSENIC [1.7] K <2 <2 <2 [5.4] K <2 7.24 70 BARIUM [27.8] [2.6] [14.3]

[13.2] [159] [3.5] -- -- BERYLLIUM [0.39] <1 [0.48] [0.59] [1.1] B [0.10] B -- -- CADMIUM <1 <1 [0.56] B [0.44] B [0.96] B [0:16] B 0.676 9.6 CALCIUM [466] [127] J [616] J [501] J [2,150] J [108] J -- -- TOTAL
CHROMIUM 3.8 [1.7] 13.4 8.7 26.4 [1.9] 52.3 370 COBALT [5.6] <10 [2.2] [5.3] [16.8] [0.78] -- -- COPPER [3.5] [0.7] [4.9] [6.9] 25.6 [1.1] 18.7 270 IRON 6,070 1,220 15,800 9,210 24,100 2,210 -- -- LEAD 2.7 <0.6 3.8 3.5 28.6 1.3 30.24 218 MAGNESIUM [248] [53.7] J [414] J [349] J [2,590] J [34.5] J -- -- MANGANESE 421 J 25 46 200 1,710 52.8 -- -- MERCURY <0.I <0.1 <0.1 <0.1 [0.23] <0.1 0.13 0.71 NICKEL [3.2] <8 [3.3] [3.0] 46.4 <8 15.9 51.6 POTASSIUM [188] [90.9] J [159] J [148] J [1,430] J [85.6] J -- -- SELENIUM [1.3] B <1 1.6 K [1.1] K [2.9] K <1 -- -- SILVER <2 <2 [0.38] <2 <2 <2 0.73 3.7 SODIUM [465] K [263] K [664] K [518] K [1,530] K [267] K -- -- VANADIUM [5.6] [1.3] 20.2 15.8 [29.1] [3.0] -- -- ZINC 24.6 6.8 K 11.4 24.1 105 6.7 K 124 410 Qualifiers: J = analyte present, reported value may not be accurate or precise; B = not detected substantially above the level reported in laboratory or field blanks; [ ] = analyte present, as values approach the instrument detection limit the quantitation may not be accurate; K = analyte present, reported value may be biased high, actual value is expected to be lower; Green box indicates levels that exceed 3X background; Blue highlight indicates levels that exceed NOAA SQRT TEL.
1-National Oceanic and Atmospheric Administration Screening Quick Reference Table for Inorganics in Solids (Marine Sediments)

Table 13 – VOC data for Sediment Samples
Analyte
mg/kg SED1
Bkgrnd SED2
(Dup SED6) SED3 SED4 SED5 SED6
(Dup SED2) NOAA1
SQRT
(TEL) NOAA1
SQRT
(ERM) ACETONE 29 J 2 B 4 B 4 B <10 <10 -- -- METHYLENE CHLORIDE 61 B 15 B 11 B 6 B 35 B 20 B -- -- Qualifiers: J = analyte present, reported value may not be accurate or precise; B = not detected substantially above the level reported in laboratory or field blanks.
1-National Oceanic and Atmospheric Administration Screening Quick Reference Table for Inorganics in Solids (Marine Sediments)

Table 14 – SVOC data for Sediment Samples
Analyte
(g/kg SED1
Bkgrd SED2
(Dup SED6) SED3 SED4 SED5 SED6
(Dup SED2) NOAA1
SQRT
(TEL) NOAA1
SQRT
(ERM) CAPROLACTAM <330 <330 58 J <330 <330 <330 -- -- BIS(2-ETHYLHEXYL)PHTHALATE 490 B 150 B 190 B 150 B <330 180 B -- -- Qualifiers: J = analyte present, reported value may not be accurate or precise; B = not detected substantially above the level reported in laboratory or field blanks.
1-National Oceanic and Atmospheric Administration Screening Quick Reference Table for Inorganics in Solids (Marine Sediments)

Table 15 - Pesticide and PCB data for sediment samples
Analyte
(g/kg SED1
Background SED2
Dup. SED6 SED3 SED4 SED5 SED6
Dup. SED2 NOAA
SQRT
(TEL) NOAA
SQRT
(ERM) ALPHA-BHC 4.5 <1.7 <1.7 <1.7 10 J <1.7 -- -- Qualifiers: J = analyte present, reported value may not be accurate or precise.
1-National Oceanic and Atmospheric Administration Screening Quick Reference Table for Inorganics in Solids (Marine Sediments)

6.4 Soil Sampling Results

MDE collected fourteen surface soil samples (including one duplicate) and ten subsurface soil samples (including one duplicate) for a total of twenty-four soil samples in and around the Firehole. Samples SS-7, SS-10, SS-13 and SS-14 were also proposed for collection, but refusal at less than 18 inches precluded collection of those samples. Contaminants detected were screened against MDE Cleanup Standards for Residential Soils and EPA Region III RBCs for Residential Soils. Additionally, all soil samples were analyzed for perchlorates and nitroaromatic compounds.

Barium, arsenic, cadmium, calcium, copper, lead, magnesium, manganese, mercury and zinc exceeded 3X background in the surface soils for the inorganics. Most of the exceedances, and the highest concentrations, were in samples S13 and S14, which were collected directly in the Firehole. Concentrations of aluminum, arsenic, barium, cadmium, total chromium, iron, lead, manganese, mercury, thallium and zinc

exceeded screening levels. Tetrachloroethene was detected in S-13, and Tetrachloroethene and TCE were detected in S-14. Concentrations detected for these VOCs did not exceed the screening levels. Bis(2-ethylhexyl)phthalate, PCBs (Aroclor 1254), and a spectrum of pesticides were detected at concentrations greater than 3X background; however none of the concentrations exceeded the screening levels. There was one detection of Benzo(a)pyrene in S-13 slightly greater than the EPA RBC. The nitroaromatic compounds 1,3,5-Trinitrobenzene, 2,4,6-Trinitrotoluene, 4-amino 2,6-Dinitrotoluene, 2-amino 4,6-Dinitrotoluene and Dinitrotoluene mix were detected in S3, S6, S8, S13 and S14, although concentrations did not exceed screening levels. No perchlorates were detected in the surface soil samples.

In the subsurface soils samples, only barium, calcium, magnesium, selenium, thallium and zinc exceeded 3X background. Concentrations of aluminum, arsenic, iron, manganese, and thallium exceeded either one or both of the screening levels for inorganics. DDT and Heptachlor epoxide exceeded 3X background, but no concentrations of pesticides detected exceeded the screening levels. 2,4,6-Trinitrotoluene, 4-amino 2,6-Dinitrotoluene and 2-amino 4,6-Dinitrotoluene was detected only in SS6, but concentrations did not exceed the screening levels. No perchlorates were detected in any of the subsurface soil samples.

Table 16 - Inorganic Data for Surface Soils
Analyte
mg/kg S1
Bgrd S2 S3 S4 S5
DUP
S12 S6 S7 S8 S9 S10 S11 S12
Dup
S5 S13 S14 EPA1
RBC MDE2
Cleanup

Stnd. ALUMINUM 11,400 8,010 7,270 7,950 8,300 10,200 7,390 8,990 10,300 9,460 13,000 7,520 10,200 9,770 78,000 7,800 ANTIMONY <12 <12 <12 <12 <12 [0.95] L <12 <12 [2.5] [0.97]L <12 [2.9] L [1.5] L [4.1] L 31 12 ARSENIC 2.7K 2.7K 2.7 K [2.3] K 2.6 K 4.8 [2.4] K 4.1 K 3.4 K 4.8 4.9 9.0 4.9 5.6 0.43 2 BARIUM [26.7] 101 88.2 48.4 64.6 688 [47.3] 139 280 51.2 70.2 91.9 311 1,010 5,500 550 BERYLLIUM [0.62] [0.7]K [0.75] [0.71] [0.88] [0.67] [0.71] [0.5] [0.88] [0.68] [0.81] [0.91] [1.1] [0.54] 160 16 CADMIUM [0.53]B [0.56]K [0.31] B [0.37] B [0.48] B 1.9 K <1 2.2 K [0.35] [0.52] B [0.69]B 1.5 K 3.3 12.5 39 3.9 CALCIUM [367]J 1,580 J [658] J [488] J [888] J [1,070] J [170] [942] J [534] [565] J [1,010] J [915] J 1,610 J 2,070 J -- -- TOTAL CHROMIUM 25.1 14.6 12.1 11.4 13.5 21.6 10.9 17.6 17.3 16.7 20.7 15.2 21.2 51.1 230 (Cr+6) 23 (Cr+6) COBALT 12.9 [5.9] [4.8] [3.8] [8.8] [5.8] [4.3] [5.1] [7.4] [5.4] [7.4] [10.2] [6.7] [5.1] 1,600 160 COPPER 17 10.3 7.4 12.1 11.0 31.3 7.9 35.0 333 8.8 10.9 88.1 176 777 3,100 310 IRON 26,100 12,700 10,700 10,700 12,300 14,800 9,620 13,900 15,100 14,000 18,400 39,200 20,600 19,300 23,000 2,300 LEAD 12.3 18.2 11.2 13.3 15.3 49.4 17 142 20.6 15.3 14.1 22.9 305 1,480 -- 400 MAGNESIUM [1,040]J 1,370J [843] J [799] J [1,100]J 3,340J [821] 1,560 J 1,540 1,200 J 1,720 J [1,080] J 1,360 J 1,380 J -- -- MANGANESE 164 272 204 283 461 316 239 J 192 301J 210 273 899 485 673 1,600 160 MERCURY <0.1 [0.06] <0.1 <0.1 [0.10] [0.09] [0.08] <0.1 0.16 <0.1 <0.1 0.15 3.5 0.18 -- 0.1 NICKEL [8.3] [7.1] [4.7] [5.8] [6.0] 9.6 [6.2] [7.5] 11.3 [6.9] 9.7 12.7 11.4 17.5 1,600 160 POTASSIUM [528]J [482]J [289] J [322] J [351] J [518] J [327] [717] J [759] [464] J [560] J [313] J [588] J [546] J -- -- SELENIUM 1.5K <1 [0.90] K <1 <1 2.0 K <1 <1 1.4 B 1.4 K 1.5 K 2.4 K 1.8 K [0.89] K 390 39 SILVER [0.61] [0.23] <2 <2 [0.36] [1.5] [0.26] [0.31] <2 [0.25] [0.28] [1.1] [0.91] [1.0] 390 39 SODIUM [900]K [611]K [601] K [643] K [636] K [888] K [563] K 2360 K [724] K [650] K [838] K 1250 K [1,010] K 1,300 K -- -- THALLIUM 3.3L <2 [2.2] <2 [1.5] <2 <2 <2 <2 <2 <2 2.8 [2.3] [2.3] 5.5 2 VANADIUM 37.1 22.3 17.9 18.0 20.9 25.8 16.7 23.3 24.6 24.6 31.1 20.5 26.3 22.7 550 55 ZINC 19.2 27.7 25.1 28.2 28.4 335 25.1 4,010 184 29.8 28.4 41.5 495 1,250 23,000 2,300 CYANIDE <0.5 <0.5 <0.5 <0.5 <0.5 <0.5 [0.31] <0.5 <0.5 [0.16] <0.5 <0.5 <0.5 <0.5 [0.11] 1600 160 Qualifiers: J = analyte present, reported value may not be accurate or precise; L=Analyte present, reported value may be biased low, actual value is expected to be higher; K = analyte present, reported value may be biased high., actual value is expected to be lower; [ ] = analyte present, as values approach the instrument detection limit the quantitation may not be accurate.

Green box indicates levels that exceed 3X background; Yellow highlight indicates levels that exceed MDE cleanup standards; Red highlight indicates levels that exceed both MDE cleanup standards and RBCs.

1 – EPA Region III Risk Based Concentrations for Residential Soils.

2 – MDE Cleanup Standards for Residential Soils.

Table 17 - Inorganic Data for Subsurface Soils*

Analyte

mg/kg SS1

Bgrd SS2 SS3 SS4 SS5

DUP

SS12 SS6 SS8 SS9 SS11 SS12

Dup

SS5 EPA RBC1

MDE Cleanup Stnd2 ALUMINUM 9,520 12,700 9,630 1,680 4,560 3,890 6,880 9,290 12,700 4,000 78,000 7,800 ANTIMONY <12 <12 <12 <12 [1.5] L [0.93] <12 <12 [1.0] [1.5] 31 12 ARSENIC [2.1] K 3.4 K <2 [0.98] K <2 [1.4] K 2.7 K 2.9 K 4.7 [1.4] K 0.43 2 BARIUM [25.1] 55.6 96.4 [7.2] [32.8] [37.0] [35.8] [28.7] [45.5] [30.3] 5,500 550 BERYLLIUM [1.0] [0.61] 1.5 [0.2] B [0.43] [0.41] [0.58] [0.52] [0.54] [0.73] 160 16 CADMIUM [0.47] [0.16] [0.22] B <1 1.5 B <1 [0.39] B [0.14] [0.16] [0.82] 39 3.9 CALCIUM [391] [249] [904] J [128] 2400 J [229] [446] J [363] [314] 1960 -- -- TOTAL

CHROMIUM 33.8 20.6 17 21.3 72.3 18.0 13.6 16.0 21.1 99.8 230 (Cr+6) 230 (Cr+6) COBALT 23.3 [4.7] [3.2] [2.0] [3.7] [4.8] [4.4] [4.1] [3.5] [5.7] 1,600 160 COPPER 16.8 8.8 [4.6] 10.4 15.2 7.4 10.6 15.9 9.6 17.5 3,100 310 IRON 34,600 18,800 4,530 6,800 61,800 8,270 13,400 14,500 17,000 75,400 23,000 2,300 LEAD 12.6 9.2 9.0 4.4 3.8 8.2 11.7 6.0 7.8 3.7 -- 400 MAGNESIUM [550] 1850 [751] J [117] 1860 J [956] 1270 J 1280 [1020] 1440 -- -- MANGANESE 289 J 67.3 J 136 59.8 J 68.0 116 J 103 92.2 J 72.5 J 117 J 1,600 160 NICKEL [8.7] [9.2] [5.3] [1.3] [4.6] [5.8] [5.5] [6.6] [8.2] [4.4] 1,600 160 POTASSIUM [353] [575] [319] J [118] [522] J [267] [562] J [554] [461] [438] -- -- SELENIUM 1.2 B [0.95] B [1.2] K <1 2.1 K [0.95] J <1 [0.85] J [1.1] B 1.5 J 390 39 SILVER [0.75] [0.22] <2 [0.29] [1.7] [0.28] [0.21] <2 [0.26] [1.5] 390 39 SODIUM [969] K [752] K [618]K [353] K 1710 K [402] K [714] K [603] K [613] K 1,780 K -- -- THALLIUM <2 <2 <2 <2 6.4 <2 <2 <2 <2 [2.5] 5.5 2 VANADIUM 31.4 30.0 [10.9] [9.1] [12.4] 12.4 21 24.5 25.6 19.5 550 55 ZINC 20.9 19.8 16.8 5.2 37.9 25.6 239 24.2 13.8 28.0 23,000 2,300 Qualifiers: J = analyte present, reported value may not be accurate or precise; B = not detected substantially above the level reported in laboratory or field blanks; [ ] = analyte present, as values approach the instrument detection limit the quantitation may not be accurate; L=Analyte present, reported value may be biased low, actual value is expected to be higher; K = analyte present, reported value may be biased high., actual value is expected to be lower.

Green box indicates levels that exceed 3X background; Blue highlight indicates levels that exceed RBCs; Yellow highlight indicates levels that exceed MDE cleanup standards; Red highlight indicates levels that exceed both.

1 – EPA Region III Risk Based Concentrations for Residential Soils.

2 – MDE Cleanup Standards for Residential Soils.

* - Samples SS-7, SS-10, SS-13 and SS-14 not collected due to refusal.

Table 18 – VOC Data for Surface Soil Samples

Analyte

?g/kg S1

Bkgd S2 S3 S4 S5 S6 S7 S8 S9 S10 S11 S12 S13 S14 EPA RBC[1] MDE Cleanup Stnd[2] METHYLENE CHLORIDE **12 B 11 B 9 B 9 B 9 B 40 B 39 B 19B 40 B 11 B 11 B 16 B 20 B 27 B** 85,000 85,000 TETRACHLOROETHENE *<10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10* **21** 32,000 12,000 TRICHLOROETHENE *<10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10* **37 160** 1,600 58,000 TRICHLOROFLUOROMETHANE *<10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10 <10* **2 J** *<10* **3 J** 23,000,000 -- Qualifiers: J = analyte present, reported value may not be accurate or precise; B = not detected substantially above the level reported in laboratory or field blanks. Green box indicates levels that exceed 3X background.

1 – EPA Region III Risk Based Concentrations for Residential Soils.

2 – MDE Cleanup Standards for Residential Soils.

Table 19 – VOC Data for Subsurface Soil Samples*

Analyte

?g/kg SS1

Bkgrnd **SS2 SS3 SS4 SS5 SS6 SS8 SS9 SS11 SS12 EPA RBC[1] MDE Cleanup Stnd.[2]** ACETONE *<10 <10 <10 <10 <10* **6 J 2 B** *<10 <10* **3 B** 7,800,000 780,000 METHYLENE CHLORIDE **25 B 32 B 11 B 25 B 10 B 17 B 12 B 14 B 28 B 15 B** 85,000 85,000 Qualifiers: J = analyte present, reported value may not be accurate or precise; B = not detected substantially above the level reported in laboratory or field blanks.

1 – EPA Region III Risk Based Concentrations for Residential Soils.

2 – MDE Cleanup Standards for Residential Soils

* - Samples SS-7, SS-10, SS-13 and SS-14 not collected due to refusal.

Table 20 – SVOC Data for Surface Soil Samples

Analyte
ug/kg S1

Bgnd **S2 S3 S4 S5 S6 S7 S8 S9 S10 S11 S12 S13 S14 EPA RBC**[1] **MDE Cleanup Stnd.**[2] BENZO(A)ANTHRACENE *<330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330* **82 J** 870 870 BENZO(A)PYRENE *<330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330* **89 J** 87 330 BENZO(B)FLUORANTHENE *<330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330* **69 J** 870 870 BENZO(K)FLUORANTHENE *<330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330* **100 J** 8,700 8,700 BIS(2-ETHYLHEXYL) PHTHALATE **180 B 240 B 220 B** *<330* **140 B** *<330* **380 B 200 B** *<330 <330* **1400** *<330* **290 B 170 B** 46,000 46,000 CAPROLACTAM *<330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330* **42 J** 39,000,000 -- CHRYSENE *<330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330* **94 J** 87,000 87,000 DI-N-BUTYLPHTHALATE *<330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330* **83 J 250 J** 7,800,000 780,000 FLUORANTHENE *<330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330* **59 J** 3,100,000 310,000 INDENO(1,2,3-cd)PYRENE *<330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330* **54 J** 870 870 PYRENE *<330 330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330 <330* **70 J** 2,300,000 230,000

Qualifiers: J = analyte present, reported value may not be accurate or precise; B = not detected substantially above the level reported in laboratory or field blanks; Green box indicates levels that exceed 3X background; blue highlight indicates levels that exceed RBCs.

1 – EPA Region III Risk Based Concentrations for Residential Soils.

2 – MDE Cleanup Standards for Residential Soils.

Table 21 – SVOC Data for Subsurface Soil Samples*

Analyte
ug/kg SS1

Bkgrnd **SS2 SS3 SS4 SS5 SS6 SS8 SS9 SS11 SS12 EPA RBC**[1] **MDE Cleanup Stnd.**[2] BIS(2-ETHYLHEXYL)PHTHALATE **200 B 480 B** *<330* **1000 B** *<330* **180 B** *<330* **530 B 220 B 230 B** 46,000 46,000 Qualifiers: B = not detected substantially above the level reported in laboratory or field blanks

1 – EPA Region III Risk Based Concentrations for Residential Soils.

2 – MDE Cleanup Standards for Residential Soils

* - Samples SS-7, SS-10, SS-13 and SS-14 not collected due to refusal.

Table 22 - Pesticide and PCB Data for Surface Soil Samples

Analyte
ug/kg S1
Bgrd S2 S3 S4 S5
Dup
S12 S6 S7
S8 S9 S10 S11 S12
Dup
S5 S13 S14 EPA RBC[1] MDE Cleanup Stnd.[2]

ALPHA-BHC *<1.7 <1.7 <1.7* **3.6** *<1.7* **6.1 J 3.5** *<1.7* **3.1** *<1.7 <1.7 <1.7 <1.7 <1.7* 100 2,900

ENDOSULFAN I *<1.7 <1.7 <1.7 <1.7 <1.7 <1.7 <1.7 <1.7 <1.7 <1.7 <1.7 <1.7* **2.1 J** *<1.7 <1.7* -- 47,000

DIELDRIN *<3.3 <3.3 <3.3 <3.3 <3.3 <3.3 <3.3 <3.3* **7.65** *<3.3 <3.3 <3.3 <3.3 <3.3* 40 40

ENDRIN *<3.3 <3.3 <3.3 <3.3 <3.3 <3.3 <3.3 <3.3 <3.3 <3.3 <3.3 <3.3* **4.1 J** *<3.3 <3.3* 23,000 2,300

ENDOSULFAN II *<3.3 <3.3 <3.3 <3.3 <3.3 <3.3 <3.3 <3.3* **13** *<3.3 <3.3* -- 47,000

4,4'-DDD *<3.3 <3.3 <3.3 <3.3 <3.3 <3.3 <3.3 <3.3* **8.5 J** *<3.3 <3.3* **8.9 J** *<3.3 <3.3* 2,700 2,700

4,4'-DDT *<3.3 <3.3 <3.3 <3.3 <3.3 <3.3 <3.3 <3.3 <3.3 <3.3* **5.5 J** *<3.3 <3.3* **9.5 J** **1400+** *<31* 3900 1,900

ENDRINE KETONE *<3.3 <3.3 <3.3 <3.3 <3.3 <3.3 <3.3 <3.3 <3.3 <3.3 <3.3 <3.3 <3.3 <3.3 <3.3* **3.9 J** *<3.3 <3.3* -- 2,300

ENDRIN ALDEHYDE *<3.3* **4.0 J** *<3.3 <3.3 <3.3 <3.3 <3.3 <3.3 <3.3* **7.6** *<3.3 <3.3* **9.0 J** *<3.3 <3.3* -- 2,300

ALPHA-CHLORDANE *<1.7 <1.7 <1.7 <1.7 <1.7 <1.7 <1.7 <1.7 <1.7 <1.7 <1.7 <1.7* **6.6** *<1.7 <1.7* -- 1,800

GAMMA-CHLORDANE *<1.7 <1.7 <1.7 <1.7 <1.7 <1.7 <1.7 <1.7 <1.7 <1.7 <1.7 <1.7 <1.7 <1.7 <1.7* **6.7** *<1.7* **4.6 J** -- 1,800

TOXAPHENE *<170* **160 J** *<170 <170 <170 <170 <170 <170* **470 86 J** *<170* **610** *170 <170* 580 580

HEPTACHLOR EPOXIDE *<1.7 <1.7 <1.7 <1.7 <1.7 <1.7 <1.7 <1.7* **4.2 J** *<1.7 <1.7 <1.7 <1.7 <1.7* **3.1 J** 70 70

AROCHLOR-1254 *<33 <33 <33 <33 <33 <33 <33 <33 <33 <33 <33 <33 <33* **190** 320 320

Qualifiers: J = analyte present, reported value may not be accurate or precise; + = 10X dilution; Green box indicates levels that exceed 3X background

1 – EPA Region III Risk Based Concentrations for Residential Soils.
2 – MDE Cleanup Standards for Residential Soils.

Table 23 - Pesticide and PCB Results for Subsurface soil samples*

Analyte

µg/kg **SS1**

Bgrd **SS2 SS3 SS4 SS5 SS6 SS8 SS9 SS11 SS12 EPA RBC[1] MDE Cleanup Stnd.[2]**ALPHA-BHC **6.2 3.6 J** *<1.7* **12** *<1.7* **3.4 2.6 3.1 2.2** *<1.7* 100 2,900 4,4'-DDT *<3.3 <3.3 <3.3 <3.3 <3.3* **12** *<3.3<3.3<3.3 <3.3* 1,900 1,900 HEPTACHLOR EPOXIDE *<1.7 <1.7* **2.9 J** *<1.7 <1.7<1.7 <1.7 <1.7 <1.7 <*1.7 70 70 Qualifiers: J = analyte present, reported value may not be accurate or precise; Green box indicates levels that exceed 3X background.

1 – EPA Region III Risk Based Concentrations for Residential Soils.

2 – MDE Cleanup Standards for Residential Soils

* - Samples SS-7, SS-10, SS-13 and SS-14 not collected due to refusal.

Table 24 – Nitroaromatic Compound Results for Soil Samples

Analyte

µg/kg **S3 S6 SS6 S8 S13 S14 EPA**

BC[1] MDE Cleanup Stnd.[2]1,3,5-TRINITROBENZENE **-- 90** -- -- -- -- 2,300,000 -- 2,4,6-TRINITROTOLUENE **40 J 963 124 -- 35J 1,390** 21,000 -- 4-AMINO 2,6-DINITROTOLUENE **-- 1,530 123 47.5 -- 580** 78,000 -- 2-AMINO 4,6-DINITROTOLUENE **150 J 1,260 98 14 J --- 470** -- -- DINITROTOLUENE MIX **-- 110 -- 110 -- 90**940 --

1 – EPA Region III Risk Based Concentrations for Residential Soils.

2 – MDE Cleanup Standards for Residential Soils.

7.0 FINDINGS AND CONCLUSIONS

A toxicological evaluation was prepared for the Firehole site, assuming a residential future use scenario for the site. Risk estimates exceeded EPA and MDE recommended levels for the child resident population for incidental ingestion of and dermal contact with surface soils, with the risk drivers of potential additive effects, chromium, and arsenic. Concentrations detected exceeded the EPA and MDE recommended levels for ingestion of and dermal contact with subsurface soil for the child resident, with the risk drivers of potential additive effects and chromium. Lead was detected in S14 at 1480 mg/kg, which may pose a threat to sensitive populations and the environment. Risk estimates for the incidental ingestion of and dermal contact with groundwater exceeded MDE and EPA recommended levels for all residential populations, with trichloroethene as the risk driver.

Samples S13 and S14 were collected in the area defined by MDE's geophysical survey (Appendix ?) as the most likely area of the Firehole. Sample analysis showed elevated concentrations of lead, mercury, and arsenic as well as TCE and Aroclor 1254, and the nitroaromatic compound TNT and associated daughter products. The groundwater collected from monitoring well MW2, which is hydraulically downgradient of S13 and S14, was contaminated with significant concentrations of TCE. Subsurface soil samples from the Firehole area were not collected because of refusal at less than 18 inches. Sample S/SS 6 obtained from the vicinity of the TMRA and sample S8 midway between the Firehole and TMRA also exhibited elevated levels of several explosive compounds

According to the current owners of the property, the Elkton Farm property is for sale. It is currently leased to farmers in the area for crops; however, in all likelihood, the entire 300-acre farm will be developed for residential use in the future, rather than continued use for farming. The presence of TNT and daughter products, elevated concentrations of metals, highly volatile TCE detected in surface soils and groundwater and the presence of ordnance-related debris easily observable on the ground surface all suggest that further investigation is necessary in order to fully identify any human health risks to future residential populations.

8.0 REFERENCES

Site Survey, Elkton Farm Site, Maryland Department of the Environment, April, 2001

Soil Survey of Cecil County, Maryland,. United States Department of Agriculture, December 1973

The Geology of Cecil County, Maryland, Bulletin 37, Department of Natural Resources, Maryland Geological Survey, 1990.

Generalized Geological Map of Maryland, Maryland Geological Survey. 1967

Interview with Mr. Richard Herron, March 27, 2003.

NAEVA Geophysics, Inc., ***Results of Triumph Explosives Facility, Zeitler Road, Elkton, MD,*** September 3, 2002.

Toxicological Evaluation-Elkton Farm Firehole, Maryland Department of the Environment, October 16, 2003